Assignment 2.

1. Case study (Bootstrap for Euribor 3M Interbank curve):
Considering the interbank market on the 31st of January 2023 at 10:45 C.E.T. write a Matlab code that realizes the bootstrap for the Discount Factors' curve (with a single-curve model).
Output values should be on settlement date and expiries of quoted underlyings.
Hints:

a. create a complete set of swap rates (with expiry after each year from 2y up to 50y with a *modified following* convention) from the ones in the excel file MktData_CurveBootstrap.xls. Notice that you have yearly swaps till 12 years and then 15y, 20y…
   To have a complete set of swaps you should first select the settlement date with a *modified following* convention (e.g. on February 2036 the 2nd of February is a Saturday, then the settlement day with this convention is Monday the 4th of February 2036) and then use spline interpolation on mid rates (with act/365 yearfrac convention for the time) to obtain the swap rates.
b. include in the datesSet of the bootstrap only end dates of underlying contracts (included all swap rates in the complete set).

Q: Bootstrap is not the only technique to obtain Discount Factors (DFs) from quoted rates. Why is it so relevant the bootstrap of DFs in finance?

2. Exercise
Price a 7y "I.B. coupon bond" issued on the 31st of Jan '23 with coupon rate equal to the corresponding mid-market 7y swap rate. Assume for the coupons a 30/360 European day count and a Face Value 100 Mln; it has same expiry, fixed rate & reset dates of the IRS.
Hint: Shortcuts are appreciated.

3. Exercise (DV01 for an IRS, Modified duration for a coupon bond)
With the discount curve obtained above compute (the absolute value of the quantities specified below) for a portfolio composed only by one single swap, a 7y plain vanilla IR swap *vs* Euribor 3m with a fixed rate 2.8175% and a Notional of €100 Mln:
i) DV01-parallel shift;
ii) $DV01^{(z)}$-parallel shift;
iii) BPV of the 7y IRS;
iv) the Macaulay Duration of the "I.B. coupon bond" above.
Comment the results.

4. Exercise
With the discounting curve you've obtained at point 1, compute the NPV of a set of monthly cash flows received on the 25th of each month for 20y, starting from September 2026, with an Average Annual Growth Rate (AAGR) of 5%, in two cases:

a. when the initial monthly cash flow is 1.5K €;
b. when the initial monthly cash flow is 6.0K €.

The AAGR growth rate is applied each year in September.

Function signatures

a. [dates, discounts]=bootstrap(datesSet, ratesSet);
b. zRates = zeroRates(dates, discounts); (in percentage unit, e.g. 2.13 stands for 2.13%)
c. [DV01, BPV, DV01_z] = sensSwap(setDate, fixedLegPaymentDates, fixedRate, dates, discounts,discounts_DV01); (discounts_DV01 are computed in order to determine the DV01)
d. MacD = sensCouponBond(setDate, couponPaymentDates, fixedRate, dates, discounts).